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Application for Patent

C:31597

אני, (שם המבקש, מענו -- ולגבי גוף מאוגד -- מקום התאגדותו)
I (Name and address of applicant, and, in case of body corporate-place of incorporation)

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(An Israeli company)

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רחוב המלאכה 1
אזור תעשיה צפוני
לוד 71293

(חברה ישראלית)

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(בעברית)
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(English)

WIRELESS LOCAL LOOP SYSTEM AND METHODS USEFUL THEREFOR

hereby apply for a patent to be granted to me in respect thereof

מבקש בזאת כי ינתן לי עליה פטנט

*בקשה חלוקה - Application for Division	*בקשת פטנט מוסף - Application for Patent of Addition	*דרישה דין קדימה Priority Claim		
מבקשת פטנט from Application	*לבקשה/לפטנט to Patent/Appl.	מספר/סימן Number/Mark	תאריך Date	מדינת האיגוד Convention Country
No._____ מס. dated_____ מיום	No._____ מס. dated_____ מיום			

*יפוי כח: כללי/מיוחד - רצוף בזה / עוד יוגש
P.O.A.: general / individual - attached / to be filed later -
filed in case_____ הוגש בעניין

המען למסירת הודעות ומסמכים בישראל
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חתימת המבקש
Signature of Applicant

For the Applicant,

Sanford T. Colb & Co.
C:31597

היום ___7___ בחודש _DECEMBER_ שנת _1998_
This of of the year

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מערכת עם לופ לוקלי אלחוטי ושיטות השמושיות עבורה

WIRELESS LOCAL LOOP SYSTEM AND METHODS USEFUL THEREFOR

RDC COMMUNICATIONS LTD.

אר. די. סי. תקשורת בע"מ

C:31597

WIRELESS LOCAL LOOP SYSTEM AND METHODS USEFUL THEREFOR

FIELD OF THE INVENTION

The present invention relates to communication systems generally and more particularly to wireless local loop systems.

BACKGROUND OF THE INVENTION

Wireless local loop systems are known.

IP is the conventional Internet protocol.

The disclosures of all publications mentioned in the specification and of the publications cited therein are hereby incorporated by reference.

SUMMARY OF THE INVENTION

The present invention seeks to provide a Wireless Local Loop (WLL) system whose scheme of operation comprises an Internet protocol (IP) packet switching scheme rather than a circuit switching scheme. This Wireless (Internet Protocol) Local Loop (WipLL) system seeks to provide an "all-in-one" broadband access solution for the operator, supporting a variety of data and voice applications on a single integrated platform.

The present invention provides a shared media that is used by all customers in the most optimal way due to its packetized air protocol. This technology enables one of the system's unique features: The ability to recognize the content of a transmission - e.g. its application - and assign Bandwidth (BW) and Quality-of-Service (QoS) accordingly.

Various data applications such as Video-conferencing, Fast-Internet access, Teleworking, E-mail, Frame-Relay and others, are each supported optimally by the present invention.

The present invention, operative as an integrated broadband terrestrial wireless system, is a complete system solution for carriers or providers of multiple fixed access services to the SME (small to medium enterprises), SOHO (small office home office) and residential marketplace including Voice, Data and Video.

The present invention has significant cost and service advantages over existing wired solutions (HFC, ADSL, FTTC) due primarily to the economic advantage of wireless deployment where customer penetration rates are not optimal and cannot be fully anticipated. The system allows new carriers, as well as incumbents, to deploy, quickly and relatively inexpensively, a full service broadband access network.

Unlike traditional circuit-switched systems, the present invention will provide more efficient BoD (Bandwidth-on-Demand) with selectable QoS which are both determined by the actual throughput data or the content.

The unique features of the present invention include the integration of multiple services, including data voice and video, on a single platform, QoS supported by advanced air protocol, bandwidth assignment according to true data throughput, wireless access with efficient spectrum use, toll quality telephony and voice band data, large coverage area - up to 25 km radius, high Base Station capacity due to capability for co-

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located multiple radio ●●s, comprehensive and user-friendly ●●work Management System and scaleability. ●

There is thus provided in accordance with a preferred embodiment of the present invention a wireless local loop system including a data network/PSTN gateway unit, at least one data line, at least one base station connected to the gateway unit via the at least one data line respectively, a multiplicity of wireless subscriber units communicating wirelessly with the base station, each wireless subscriber unit including at least one interface to at least one host including a telephone host, each subscriber unit including an analog converter operative to translate incoming information in IP packet format into analog voice representation and to feed the analog voice representation to the telephone host, and to receive incoming analog voice information from the telephone host, to translate the incoming analog voice information into IP packet formatted information and to feed the IP packet formatted information to the base station, and a packet switcher operative to perform packet switching on IP packets arriving from the base station connected to the subscriber unit, including routing IP packets for hosts other than the telephone host to those hosts and routing IP packets for the telephone host to the analog converter, and wherein the base station is operative to perform packet switching on incoming IP packets based on an IP destination address included in each incoming IP packet, and wherein the gateway unit is operative to switch incoming data packets onto the data network, to translate incoming voice packets from IP packet format into analog voice representation and to switch the analog voice representation onto the PSTN.

Further in accordance with a preferred embodiment of the present invention each host comprises one of the following group of host types: a telephone, a telefax, a computer, a data modem and a cable modem.

Still further in accordance with a preferred embodiment of the present invention the at least one data lines include wired data lines.

Additionally in accordance with a preferred embodiment of the present invention the data network comprises the Internet.

There is further provided in accordance with another preferred embodiment of the present invention a wireless local loop method providing a data network/PSTN gateway unit, at least one data lines, at least one base stations connected to the gateway unit via the at least one data lines respectively and a multiplicity of wireless subscriber

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units communicating ●elessly with the base station, each ●eless subscriber unit including at least one interface to at least one host including a telephone host, translating incoming information in IP packet format into analog voice representation and feeding the analog voice representation to the telephone host, receiving incoming analog voice information from the telephone host, translating the incoming analog voice information into IP packet formatted information and feeding the IP packet formatted information to the base station, and performing packet switching on IP packets arriving from the base station connected to the subscriber unit, including routing IP packets for hosts other than the telephone host to those hosts and routing IP packets for the telephone host to the analog converter and wherein the base station is operative to perform packet switching on incoming IP packets based on an IP destination address included in each the incoming IP packet, and wherein the gateway unit is operative to switch incoming data packets onto the data network, to translate incoming voice packets from IP packet format into analog voice representation and to switch the analog voice representation onto the PSTN.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated from the following detailed description, taken in conjunction with the drawings in which:

Fig. 1 is a simplified block diagram of the WipLL system comprising: a Base Station Unit (BSU), at least one End Point Units (EPU) and a Management System constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 2 is a simplified block diagram of a Base Station Unit constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 3 is a simplified block diagram illustrating two of the most common base station configurations constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 4 is a simplified block diagram of an Air Interface Unit (AIU) constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 5 is a simplified block diagram of an IP router constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 6 is a simplified block diagram of a Gateway and a Gatekeeper constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 7 is a simplified block diagram of an End Point Unit constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 8 is a simplified block diagram of an Integrated Indoor Data Adapter (Integrated-IDA) constructed and operative in accordance with a preferred embodiment of the present invention; and

Fig. 9 is a simplified block diagram of a typical IP network utilizing the system constructed and operative in accordance with a preferred embodiment of the present invention.

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The broadband point-to-multipoint wireless IP access system presented in this invention is comprised of three major constituents, as shown in Fig. 1:

A Base Station Unit (BSU) 10, which:

uses Routers 20 and gateways 30 to connect the System to Data Networks 40 (IP, ATM etc.) and to the PSTN 50; and

converts all transmissions to a packetized bit stream and transmits it via a wireless link to each End Point Unit (EPU) 60 in the cell .

At least one EPU 60 which exists at each subscriber end. The subscriber's EPU receives the packetized bit stream and passes said bit stream to its PC, LAN 70, telephone or other interface equipment.

A Management System 80 - that controls and manages the System. The management system recognizes the content of each packet and assigns accordingly the appropriate Quality-of-Service and bandwidth based on a prearranged Service Level Agreement. This means that spectrum not in actual use can be used by The system elsewhere - a far more effective arrangement than a circuit-switched solution.

The Base Station Unit

The BSU interfaces between the end users and the different networks according to the applications that are supported. e.g. The base station may support Ethernet, POTS and/or other applications over an IP-network. In this case the BSU will interface between the air protocol from the EPU and an IP cloud. To connect to the IP cloud a IP Router may be included in the Base Station.

Alternatively the BSU may interface between POTS (or ISDN) end users and the PSTN-network. In this case the BSU interfaces between the air protocol from the EPU and the PSTN. To connect to the PSTN cloud a Gateway may be included in the Base Station.

Thus the BSU is composed of the following elements, as shown in Fig. 2:

one or more Air Interface Units (AIU) 90, where each AIU covers a sector in the Base Station's coverage cell;

an IP Router 20 that allows interfacing to IP networks 95 (when such interface is required;.

a Gateway 30, when there is a need to interface a different network such as the PSTN; and

a Gatekeeper 100, in conjunction with that Gateway.

The maximum number of AIUs that can be co-located in a single Base Station actually depends on the allocated bandwidth. Typically, in a 20 MHz band, 10 - 16 AIUs can co-exist. Consequently, numerous AIUs can be connected to the Router using IP over Ethernet (10BaseT interface). Fig. 3 illustrates the two most common Base Station configurations. Note that each two-radio unit that co-exists in the same sector is separated by a frequency band. Six AIUs in a six-sector cell provide a capacity of about 24 Mbps/cell (about 20Mbps/cell net throughput), while twelve AIUs in such a cell will double the bit rate per cell to 40 Mbps/cell.

The Air Interface Unit (AIU)

The AIU, as shown in Fig. 4, is a necessary constituent of any base station configuration since it is responsible for the air interface with the end user equipment.

The Air Interface Unit (AIU) comprises:

a radio unit which can maintain a 4 Mbps air link (net throughput of 3.2 Mbps) with the End User's equipment;

a high powered transmitter; and

an internal high gain directional antenna that, together with said high powered transmitter, makes large cells - of up to 25 km radius - possible.

The AIU radio employs Frequency Hopping Spread Spectrum, especially useful when used in the 2.4 GHz ISM band. However, it can also be used with Dynamic Channel Assignment which increases its spectrum efficiency and improves its reuse factor.

The AIU outputs a 10BaseT Ethernet line with IP protocol, said output is used to interface, through an appropriate IP router, to IP networks.

Each AIU can co-exist with other AIUs to provide full cell coverage. e.g., 10-16 AIUs can co-exist in a 20MHz band, depending on the terrain and environmental conditions. This corresponds to a 40 - 64 Mbps/cell capacity respectively.

Each AIU radio unit in the BSU can maintain a 4 Mbps link with the subscribers in its sector. In this link the radio can maintain, for example, 50 simultaneous (64 kbps)

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voice links. Table 1 shows the number of simultaneous users connected to one BSU in a typical 6-sector cell with one AIU (radio) per sector, assuming 100 mE/subscriber and 1% GOS.

Voice @ 64 kbps	Data @ 256 kbps	Videocon @ 384 kbps
300[1]	-	-
150	38	-
125	31	8

[1] Each sector contributes 50 POTS channels.

Table 1

Table 2 shows the total number of subscribers served by one BSU in a typical 6-sector cell, with one AIU (radio) per sector, assuming 100 mE/subscriber and 1% GOS.

Voice @ 64 kbps	Data @ 256 kbps	Videocon @ 384 kbps
2280[2]	-	-
1140	300	-
950	250	67

[2] Erlang computations were performed separately for each sector and then the computed Erlang values of all 6 sectors were added.

Table 2

The IP Router

When the base station is connected to an IP network an IP Router is used in the base station. The IP-Router will interface between the AIUs of the base station and the IP-Network.

The IP-Router 20 accepts Ethernet (10BaseT) lines from each and every AIU 90 in the Base Station, and outputs an IP Ethernet (100BaseT or 10BaseT) line toward the IP network, as shown in Fig. 5.

The Gateway

The system is connected to PSTN 50 through a Gateway 30. The gateway processes PSTN signals and converts them to IP addressed packets, said packets are then fed to the router and on toward the subscribers. The interface between the router and the Gateway uses IP over Ethernet, 100BaseT.

Gateway outputs towards the PSTN are processed into the appropriate telephony signaling format.

The Gatekeeper

The gatekeeper 100 performs tasks of Call Processing, Echo Canceling and the telephony part of the network management. The gateway and gatekeeper are illustrated in Fig. 6.

The End Point Unit (EPU)

The EPU includes all the hardware that is installed at the end-user premises (excluding subscribers' end products like telephone, PC, fax, computer workstation etc.). The EPU is divided into two main parts, as shown in Fig. 7:

an Air Interface Unit (AIU) 110; and

an Indoor Data Adapter (IDA) 120 module which has an IP telephone interface and an Ethernet connection to the user's LAN or PC..

The Air Interface Unit (AIU)

The AIU in the EPU is similar to the AIU in the BSU; however, there are differences between the two.

The main function of the EPU's AIU is to interface between the Base Station and the IDA. The AIU interfaces to the Base Station using the Packet-Switched based Air Protocol, and it interfaces with the IDA using IP over an Ethernet.

Both the Air Protocol and Air Interface are similar on both sides, as are the mechanical characteristics of the AIUs.

The internal antenna in the EPU's AIU is much more directional than in the BSU's AIU since the AIU on the subscriber side is communicating to a single point only,

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namely the Base St⬤. Thus, while the Base Station's A⬤ equipped with a 60° directional antenna, the AIU in the subscriber end is equipped with a 23° antenna.

<u>The Indoor Data Adapter (IDA)</u>

The Indoor Data Adapter is the interface to the End-User's equipment. Thus, the End-User's Telephone, PC or any other data equipment like Teleconferencing, Automatic-Tele-Money (ATM), Point-of-Sale or Telemetry equipment will all be connected to IDAs.

Different IDAs are available for different applications: e.g. for LAN applications a special Ethernet IDA that interfaces to Ethernet 10BaseT LANs is available. If POTS telephones are required in addition to LAN applications then a different IDA unit, the Integrated-IDA, is required. The Integrated IDA has a Ethernet interface as before but in addition it has two POTS interfaces that can be connected to any standard phone or fax equipment. The POTS support in the System is of high quality 64 Kbps PCM. A schematic illustration of the Integrated-IDA 130 is seen in Fig. 8.

Fig. 9 illustrates a typical application of the WipLL system used as a Wireless Access system for an IP backbone cloud, constructed and operative in accordance with a preferred embodiment of the present invention.

It is noted that up to 20 AIUs can co-exist in a single BSU and many EPUs can be in every sector.

It is further noted that the System can be implemented in a single cell environment (no neighboring cells) as well as in a heavily populated multi-cell environment.

Table 3 shows the specifications of the system constructed and operative in accordance with a preferred embodiment of the present invention.

Parameter	Value	Comments
Data Channel		
AIU Data Rate	1,2,3,4 Mbps	BER and Distance Dependent

It is appreciated that the software components of the present invention may, if desired, be implemented in ROM (read-only memory) form. The software components may, generally, be implemented in hardware, if desired, using conventional techniques.

It is appreciated that various features of the invention which are, for clarity, described in the contexts of separate embodiments may also be provided in combination in a single embodiment. Conversely, various features of the invention which are, for brevity, described in the context of a single embodiment may also be provided separately or in any suitable subcombination.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described hereinabove. Rather, the scope of the present invention is defined only by the claims that follow:

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CLAIMS

1. A wireless local loop system comprising:

a data network/PSTN gateway unit;

at least one data lines;

at least one base stations connected to the gateway unit via said at least one data lines respectively;

a multiplicity of wireless subscriber units communicating wirelessly with the base station, each wireless subscriber unit comprising at least one interfaces to at least one host including a telephone host, each subscriber unit comprising:

an analog converter operative to translate incoming information in IP packet format into analog voice representation and to feed said analog voice representation to the telephone host, and to receive incoming analog voice information from the telephone host, to translate said incoming analog voice information into IP packet formatted information and to feed said IP packet formatted information to the base station; and

a packet switcher operative to perform packet switching on IP packets arriving from the base station connected to the subscriber unit, including routing IP packets for hosts other than the telephone host to those hosts and routing IP packets for the telephone host to the analog converter;

and wherein said base station is operative to perform packet switching on incoming IP packets based on an IP destination address included in each said incoming IP packet;

and wherein said gateway unit is operative to switch incoming data packets onto the data network, to translate incoming voice packets from IP packet format into analog voice representation and to switch said analog voice representation onto the PSTN.
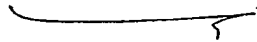
2. A system according to claim 1 wherein each host comprises one of the following group of host types:

a telephone;

a telefax;

a computer;

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a data modem; and

a cable modem.

3.   A system according to claim 1 wherein said at least one data lines comprise wired data lines.

4.   A system according to claim 1 wherein the data network comprises the Internet.

5.   A wireless local loop method comprising:

providing a data network/PSTN gateway unit, at least one data lines, at least one base stations connected to the gateway unit via said at least one data lines respectively and a multiplicity of wireless subscriber units communicating wirelessly with the base station, each wireless subscriber unit comprising at least one interface to at least one host including a telephone host, translating incoming information in IP packet format into analog voice representation and feeding said analog voice representation to the telephone host, receiving incoming analog voice information from the telephone host, translating said incoming analog voice information into IP packet formatted information and feeding said IP packet formatted information to the base station; and

performing packet switching on IP packets arriving from the base station connected to the subscriber unit, including routing IP packets for hosts other than the telephone host to those hosts and routing IP packets for the telephone host to the analog converter;

and wherein said base station is operative to perform packet switching on incoming IP packets based on an IP destination address included in each said incoming IP packet;

and wherein said gateway unit is operative to switch incoming data packets onto the data network, to translate incoming voice packets from IP packet format into analog voice representation and to switch said analog voice representation onto the PSTN.

6.   Apparatus according to any of the preceding claims 1-4 and substantially as shown and described above.

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7.   Apparatus according to any of the preceding claims 1-4 and substantially as illustrated in any of the drawings.

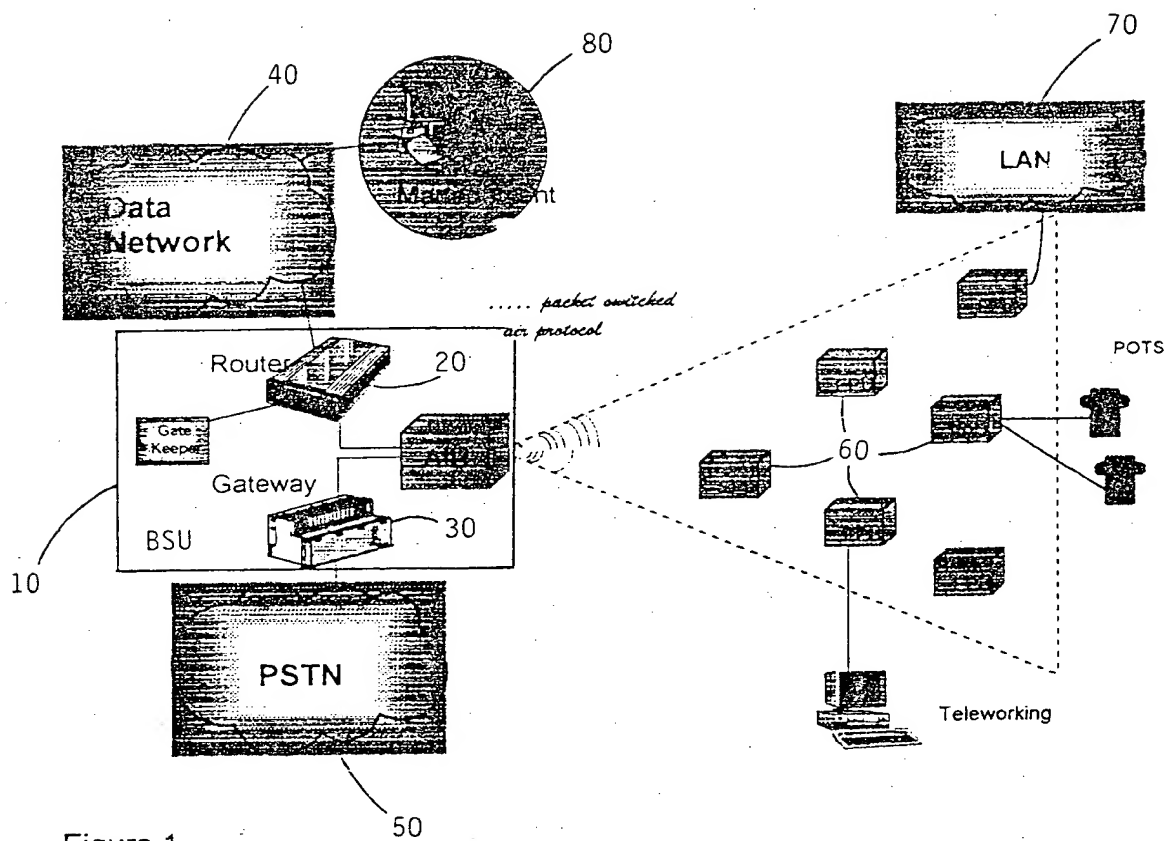8.   A method according to claim 5 and substantially as shown and described above.

9.   A method according to claim 5 and substantially as illustrated in any of the drawings.

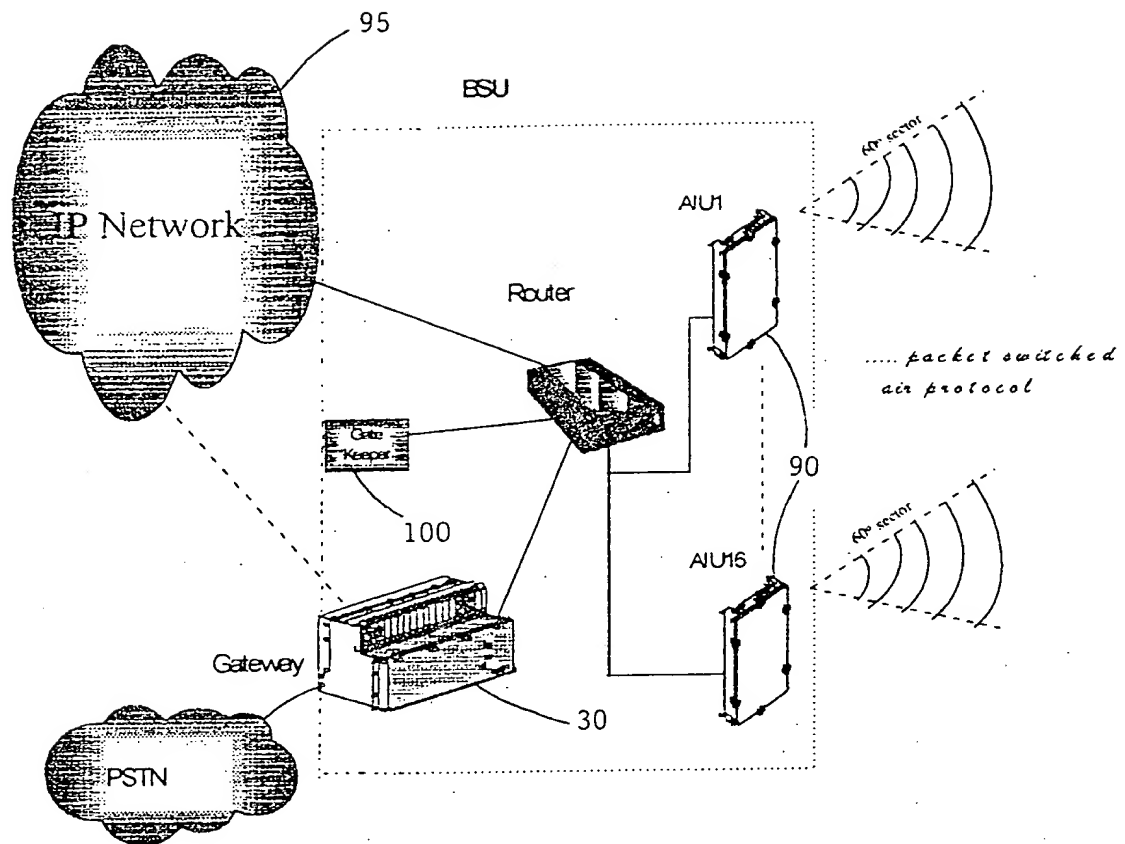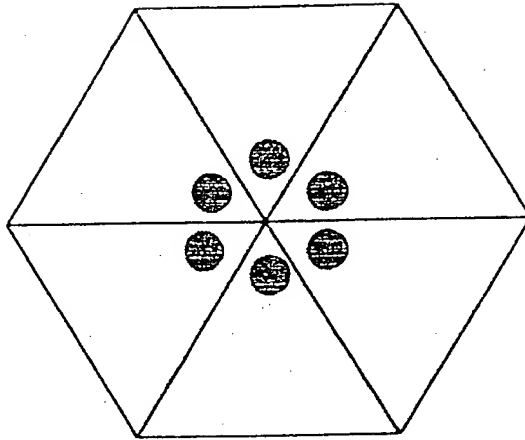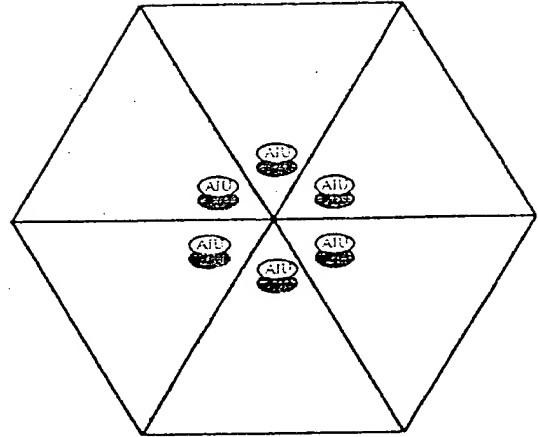For the Applicant,

Sanford T. Colb & Co.

C:31597

15

40

80

70

LAN

Data
Network

Management

POTS

..... *packet switched*
air protocol

Router

20

Gate
Keeper

Gateway

60

BSU

30

10

Teleworking

PSTN

50

Figure 1

Figure 2

6 AIUs Cell

12 AIUs Cell

Figure 3

IP over Ethernet
(10BaseT)

60° sector

..... packet switched air protocol
towards the end user

Figure 4

Router   10BaseT

Network

20

10BaseT or
100BaseT

up to 16 AIUs

90

10BaseT

Figure 5

IP Network

95

20

Router

90

Gate
Keeper

100BaseT

100

50

PSTN

Gateway

30

Figure 6

EPU

Packet Switched Air Protocol

AIU

IDA

LAN

10BaseT

23° sector

IP over Ethernet
(10BaseT)

a/b lines

110

120
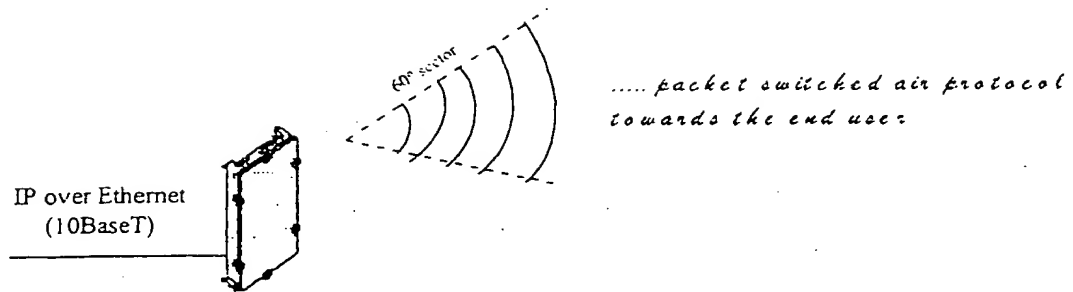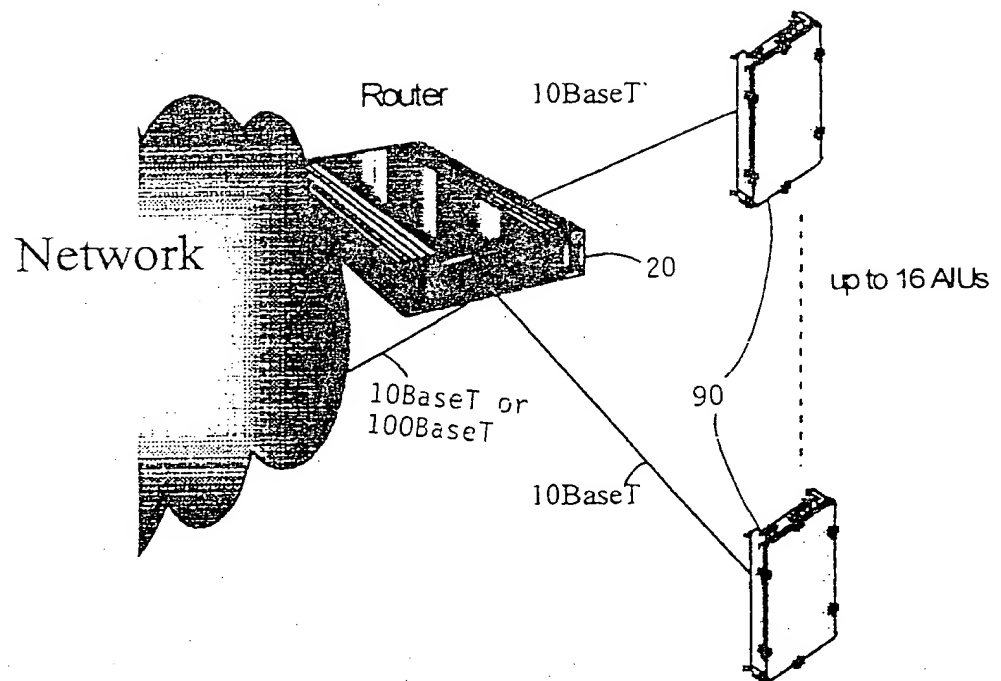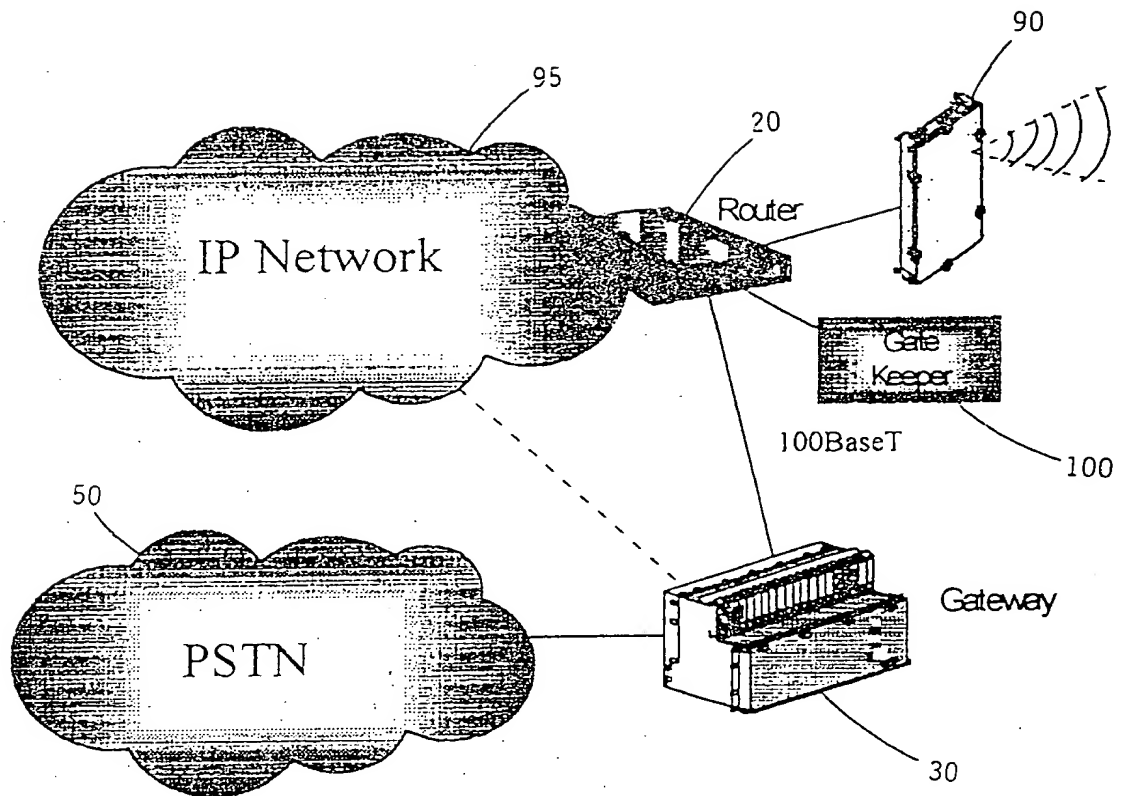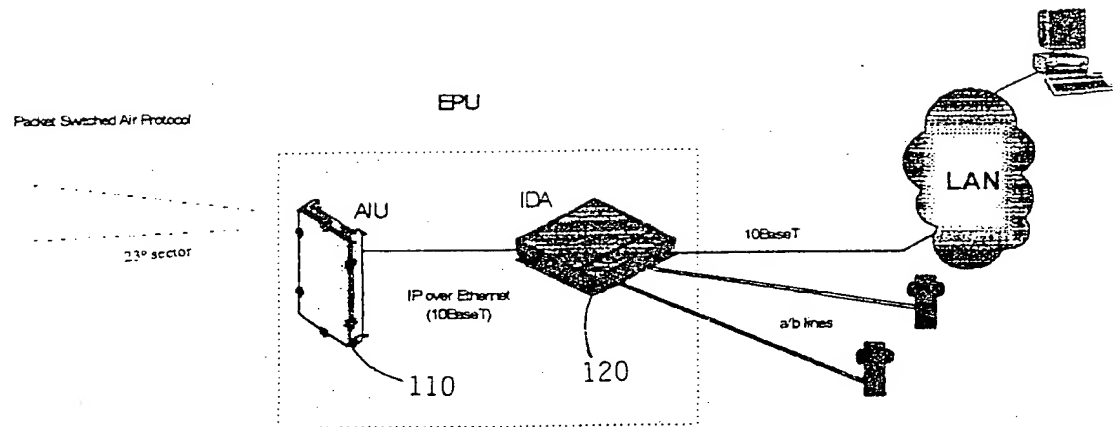
Figure 7

Figure 8

Figure 9